

*On the Animal of Millepora alcornis.**To the Editors of the Annals and Magazine of Natural History.*

GENTLEMEN,—In the communication on the animal of *Millepora*, which appeared in the 'Annals' of May last, I omitted to mention that the tubular structure, of which a woodcut was given after a drawing by Major-General Nelson, is the organic substance which remains after decalcification. It is the tubular membrane which lines the system of cavities.

It appears also that it should have been more expressly stated that the particular tubular appearance, due to the remains of old corallites whose tabulæ had disappeared, is deeply seated and more or less radial.

June 7, 1876.

Yours truly,

P. MARTIN DUNCAN.

*Deep-Sea Researches.**To the Editors of The Annals and Magazine of Natural History.*

GENTLEMEN,—I shall esteem it a favour if you will kindly accord space in 'The Annals' for the following small, but, I hope, not altogether unimportant, contribution to the *History* of Deep-Sea Research. The object in view is to prove (as stated by Sir Roderick Murchison) that I had not only in 1860 "extended the limits of animal life in the ocean to a depth of $1\frac{1}{2}$ mile, and worked out accurate data as to the varied conditions of the sea-bottom at different depths," but had also, so long ago as 1863, laid before the Council of the Royal Geographical Society a scheme for a systematic survey of the sea and sea-bed, which embodied all the most important propositions contained in the Report drawn up by Dr. Carpenter and his coadjutors for the information of the Council of the Royal Society in 1869, and by the Royal Society submitted for adoption to Government*.

In order not to trespass too far on your space, and at the same time place my statements beyond question, I annex:—first, an extract from Sir Roderick Murchison's Anniversary Address delivered at the Royal Geographical Society, May 1, 1863; and secondly, a copy of the "Scheme" referred to in his Address.

These documents will speak for themselves. I would only add that the Council of the Geographical Society did me the honour to adopt my proposals, and at once caused them to be printed—the diplomatic crisis then imminent between this country and the United States having alone stood in the way of Sir Roderick's application to the Admiralty being acceded to.

I remain, Gentlemen,

Your much obliged servant,

Herne Bay, June 15, 1876.

G. C. WALLICH, M.D.

* See Proc. Roy. Soc. vol. xviii. no. 121, dated November 18, 1869, pp. 398 and 402.

" *North-Atlantic Sea-Bed.*—In contributing to our better acquaintance with the natural history of the sea, as ascertained during the voyage of H.M.S. 'Bulldog,' under the command of Sir Leopold McClintock, Dr. Wallich* produced, by soundings at great depths, excellent materials to enable men of science to appreciate more correctly than before the feasibility of laying down a submarine telegraph between Ireland and North America. Extending the bathymetrical limits of animal life in the ocean to the great depth of 7500 feet, or $1\frac{1}{2}$ mile, beneath its surface, and working out accurate data as to the varied condition of the sea-bottom at different depths, he was well qualified to propose to our Council a scheme for such a systematic survey of the sea and sea-bed between Ireland and Newfoundland as might lead to the laying on a sound basis a submarine telegraphic cable between the two countries.

" Attributing the fears and doubts as to a successful issue of the schemes put forth chiefly to the inadequate methods hitherto employed in examining the sea-bed by the rapid transit of our surveying-ships, and by soundings taken on one line only at great distances apart, Dr. Wallich proposed that a much closer search should be made before telegraphic cables were lowered into unknown depths, and laid across submarine hills, gorges, and valleys, the irregularity of whose forms, as existing between the points hitherto sounded, might prove to be enormous. He argued that a full and proper submarine search was as essential a preliminary to a rational scheme of laying down a telegraphic cable, as a survey of the outlines of land was requisite for the engineer before he could accurately define the best and safest line to be followed by a railroad.

" Being of opinion that such an effort was well worthy of their encouragement, the Council of our Society supported the project of Dr. Wallich, not only in the belief that its execution must throw much light on this interesting branch of physical geography, but would also develop various phenomena of great interest in natural history, geology, meteorology, and physics. On my own part, being very desirous of seeing so noble an exercise of the searching powers of this great maritime nation set on foot under the management of so energetic a naturalist as Dr. Wallich, I earnestly recommended its adoption to the First Lord of the Admiralty. But, as the project matured, it speedily appeared that Dr. Wallich required two steamers for the effectual survey in question, which demand was considered to be too heavy at a moment when few vessels could be spared from our naval reserves; and hence the consideration of the subject has, for the present, been dropped. I hope, however, that in more quiet times a complete submarine survey of the Atlantic will be carried out, by the joint operations of nations on *both* sides of that ocean; and when that day arrives, I trust that the project of Dr. Wallich, with all his ingenious appli-

* " See Dr. Wallich's work, published with the sanction of the Lords of the Admiralty, entitled 'The North-Atlantic Sea-bed.' London, 1862. Van Voorst."

ances, will obtain the countenance of the public, just as in an earlier stage it has met with the approbation of the Council of the Royal Geographical Society”*.

“*Outline of a Scheme for a Systematic Survey of the Sea and Seabed between Ireland and Newfoundland, with a view to the establishment of Telegraphic Communication between the two Countries.* By G. C. WALLICH, M.D.

“Although fully sensible that it forms no part of the province of the Royal Geographical Society to discuss the commercial or social questions involved in the establishment of telegraphic communication between distant regions of the globe, I believe myself warranted in assuming that the Society has already evinced its readiness to promote, by every means in its power, those scientific inquiries which bear more or less directly on physical geography, and on the due prosecution of which the successful accomplishment of every great submarine telegraphic enterprise must principally depend.

“It is under this impression that I venture to submit to the President and Council a scheme for a systematic survey of a portion of the ocean, devised in the present instance with reference to a particular line, but which may be made equally applicable to the survey of any oceanic area.

“It is obviously needless for me to remind the Council of the fitful and fruitless efforts that have been made from time to time during the past two or three years to raise funds for the renewal of the original Mid-Atlantic Telegraph line; and it is also unnecessary for me to dwell on the inestimable benefits both of a commercial and social nature likely to accrue to Great Britain and America when the two countries shall be ‘en rapport,’ since every succeeding day only tends to bring them more vividly before the public. I allude to such matters solely with a view to show that, notwithstanding an almost universal recognition of these benefits, some deep-rooted doubt prevents both the Government and the public from lending that pecuniary encouragement to the undertaking without which it is impracticable to carry it into execution.

“This doubt, I would submit, is in a great measure attributable to the conviction that the methods of surveying the sea-bed, heretofore practised, are wholly inadequate to the requirements of the case; in other words, that the mere transit of a surveying-ship across a predetermined arc of the ocean, the investigation of the depths at intervals also predetermined, or, at all events, determined with no reference to the information evolved *en route*; and, lastly, the deceptive results sometimes incidental to the hitherto employed mode of exploring the general character of the sea-bottom; do not yield either the amount or the kind of knowledge which is essential

* Anniversary Address delivered by Sir Roderick Murchison at the Royal Geographical Society, May 25, 1863. (Proc. Roy. Geograph. Soc. vol. vii. no. 4. pp. 166, 167.)

before the costly machinery of an ocean telegraph can with safety be put in motion.

“ In saying this much, I beg emphatically to disclaim any disrespect towards the distinguished naval officers who have conducted former telegraphic surveys, and who are known to have performed their duties in the most masterly manner, and in conformity with every requirement understood to exist at the period when the task was entrusted to them.

“ In engineering operations on land, as, for example, the construction of a railway, it is customary to effect an accurate survey of the country generally through which the proposed line is to pass, with a view to the subsequent precise definition of the line in question, and it would be regarded as little short of an act of insanity on the part of a Company were it to define the exact course and order every appliance for its construction before being furnished with a detailed analysis of the difficulties to be surmounted or the geological character of the surface to be traversed. Yet this is the procedure which was adopted in oceanic telegraphy until a very recent date: the precise line from point to point having been determined as the preliminary step, the cable intended to be laid down having been manufactured without the slightest reference to the nature of the bed it was destined to rest upon, and the survey for depth having been regarded rather in the light of an accompaniment than an essential condition of the undertaking.

“ Latterly, it is true, the error and risk inseparable from such a system of conducting great telegraphic enterprises have become too palpable to be ignored, and the value of an approximate knowledge of the constitution of the sea-bed to be traversed has been recognized. But I hope to be able to satisfy the Council that, with all the improvement that has taken place on this score, much still remains to be accomplished, and that several collateral branches of inquiry involving the permanent safety of every submerged cable, in quite as important a degree as those touching the mere depth of water and the composition of the immediate surface-layer of the sea-bed, have heretofore been far too partially investigated. These inquiries, one and all, are intimately associated with physical geography and the various departments of natural science, and will therefore, I trust, be regarded as legitimate subjects for consideration by the body I have now the honour to address.

“ In order to acquire the largest amount of information from the method of survey now proposed, I beg leave to suggest that it should comprise the following heads:—

- “ 1. Soundings at such intervals as may be found necessary to ensure accurate results during the course of the Survey,—for Depth; for Specimens of Bottom; and for Depth of Deposits.
- “ 2. Examination of bottom with reference to its Mineralogical and Geological Features and Organic Products.
- “ 3. Regular observations on Temperature of Sea at its surface, and at stated intervals down to the greatest depths.
- “ 4. Observations on Density and Pressure at stated depths.

- “ 5. Observations on the Saline, Mineral, and Organic Constituents of the water from the surface downwards.
- “ 6. Observations, when practicable, on the Penetration of Light, and on the effects of immersion at great depths of the various substances employed as Coatings for Telegraphic Cables.
- “ 7. Natural History generally.
- “ 8. And, lastly, Meteorological Observations, when bearing on any of the above conditions.

“ With reference to the first of these heads (namely, soundings for depth, &c.) I may state that it ought to be regarded as an object of primary importance to *probe** the deposits of the sea-bed in every instance in which circumstances engender a suspicion that they are merely superficial films resting upon otherwise uncovered rocky or stony surfaces. That such surfaces occur in some portions of the ocean I think there is no just ground to doubt; and where they occur I would suggest that an endeavour should be made to avoid them by searching out a *détour*, if discoverable within certain limits; or, if unavoidable owing to their great extent, that measures should be devised for the strengthening or support of that portion of the telegraphic cable which traverses them.

“ I would observe that, hitherto, the bringing-up in the sounding-machine of a few grains, or even the fraction of a grain, of soft deposit, has been accepted as evidence that the bottom is composed of soft material, and not of rock, as it may unquestionably be notwithstanding.

“ The observations under the second head (namely, the nature of the deposits) demand no comment beyond allusion to their direct bearing, when taken in conjunction with the ascertained depths, on the formation of sedimentary or concretionary strata, and the evidences of their alternate upheaval and subsidence.

“ Those under the third head require a word or two of explanation.

“ Although the temperature of the ocean, from the surface downwards, has been most ably elucidated by the late Sir James Ross in the southern hemisphere, it has not, so far as I am aware, been ascertained with equal exactitude to the north of the Equator; nor has the law which regulates the equalization of that temperature along the same parallels of latitude at a certain depth below the surface been clearly established. Accordingly, every additional observation and fact which throws light on the mutual operation of terrestrial heat and surface-radiation on the waters of the ocean must prove of value in a scientific point of view, and must exercise a direct influence on the permanent safety of a submerged cable. But, irrespectively of the general law regulating the temperature of the ocean, it is by no means improbable that deep-seated tracts of water exist, along which the temperature may be materially influenced by submarine action. Although no direct data have heretofore been elicited which would lead to the suspicion that any portion of the route likely to be passed over between Ireland and

* An instrument for effecting this purpose (together with my other instruments) was exhibited by me at the meeting of the Geographical Society, January 12, 1863.

Newfoundland is subject to volcanic action, it would surely be well to satisfy ourselves of the true state of the case by direct experiment; and to adopt means for the protection of a cable against evil consequences, should proof of volcanic action, either of this or any more active kind, unfortunately manifest itself.

“The determination of temperature at regular intervals from the surface to extreme depths would also enable us to ascertain, with somewhat greater accuracy than heretofore, the vertical limits of the Gulf-stream and great tidal wave; and the point at which the waters of the ocean are influenced by the deep reflux from the Polar towards the Equatorial regions*.

“The observations comprised under the fourth head (namely, density and pressure) would of course only be carried on occasionally and under circumstances calculated to yield the most trustworthy results. The same remark applies to the observations noted under the four remaining heads †.

“Lastly, I would suggest, in the event of the survey being carried

* In Dr. Carpenter's Preliminary Report (Proc. Roy. Soc. Dec. 1868, p. 186), and Prof. Wyville Thomson's 'Depths of the Sea,' pp. 35, 302, 303), very prominent allusion is made to my having, in my North-Atlantic Sea-bed, adopted Sir John Herschel's and Sir James Ross's doctrine of a permanent temperature of 39° in the water at great depths in the ocean. In both instances the allusion is couched in terms which certainly convey the impression that Drs. Carpenter and Thomson had not just as unhesitatingly adopted the fallacy themselves. It is a remarkable circumstance, too, that in the chapter in 'The Depths of the Sea' specially devoted to "*Deep-sea Temperatures*" (where, if anywhere, the opinion of the authors prior to 1868 on so important a point ought to have been explicitly stated), the only approach to such an opinion is that which immediately succeeds a lengthy extract from my work, described by Prof. Thomson as "an excellent résumé of this fallacy given by Dr. Wallich." "There can be no doubt" (Prof. Thomson says) "that this view, which of *late* (?) years has received almost universal acceptance, is entirely erroneous" (*op. cit.* p. 304). The fact is that Prof. Thomson had so unhesitatingly adopted the fallacy that, in 'The Annals' for Aug. 1869 (p. 122), he said—"Though I had often wondered what could be the cause, I believed in this permanent temperature of the sea thoroughly, and had even suggested the particular course [for the cruise of the 'Lightning'], because it nearly coincided with the isotherm of 40° F.!" It is right that this should be clearly understood, since my sole aim in dwelling forcibly on a uniformly low temperature above the sea-bed, and over the greater portion of the deep-sea area, was to show that to its influence would be mainly attributable the general uniformity in the distribution of animal life, which has already been found to prevail over that vast area. But it was obviously immaterial to my argument whether the temperature was permanent at 39° F., or ranged from 39° to 30° , or even lower (see 'The North-Atlantic Sea-bed,' pp. 104, 105). The temperature observations taken on board the 'Bulldog' (with which I had nothing whatever to do) were unavoidably meagre and imperfect, every consideration having necessarily given place to the primary one of sounding, for depth, along a given telegraph route. It was indeed deep-sea research conducted under difficulties.

† In 1868, in Prof. Wyville Thomson's 'Depths of the Sea' (p. 52), this passage occurs:—"One or two other questions of the highest scientific interest are to be solved by our proposed investigations. 1st. The effect of pressure upon animal life, upon which there is great misappre-

into execution, and time and the primary objects permitting, that a rapid diversion from the proposed longitudinal track should be allowed on the return voyage, with a view to ascertain definitely whether soundings (in the ordinary nautical sense of the term) are to be met with in the region *about* north latitude 57° , and west longitude 30° , where, as I have endeavoured to show (in my work on the North-Atlantic Sea-bed, recently published), shoal water probably exists. I need hardly state that the discovery of soundings yielding from one to two hundred fathoms in such a locality, would be of the greatest value as affording a fresh point of departure for vessels unable, from obstacles of weather, to determine their precise whereabouts. It would also exert a deep significance in connexion with the great areas of subsidence in the North Atlantic, and the distribution of the marine and terrestrial fauna of Northern Europe and the North-American continent.

"I forbear to specify the number of observations of all kinds that might with advantage be made during the proposed voyage; being convinced that this must in a great measure depend on the information elicited *en route*, and that the rate at which the survey progresses should be regulated only by the amount and kind of knowledge obtained at every step. It may, however, be regarded as essential that not less than 300 soundings should be taken, at intervals, having due regard to depths already ascertained; and that in order to provide against unforeseen delays and contingencies, at least six months should be allowed for the completion of the enterprise.

"In submitting my project to the President and Council of the Royal Geographical Society, I am solicitous of directing attention to the results likely to accrue in the several branches of science which relate essentially to the Physical Geography, Geology, and Natural History of the Sea; and on these grounds I cherish the hope that they will exert their influence in recommending Government to grant a ship for the purpose of carrying out this survey at as early a date in the approaching season as may be deemed expedient.

"It rests with those who are competent to form an opinion on the subject to determine whether or not my proposals deserve serious consideration, and also whether I am personally qualified to undertake the various researches indicated. Should I be recommended for the duty for which I have endeavoured to fit myself, I can only say my best efforts shall be put in force to do that duty well."

hension. . . . 2nd. The effect of the great diminution of the stimulus of light. From the condition of the Cave Fauna, this latter agent probably affects only the development of colour and of the organs of sight."

The first question, as to pressure, had already been fully solved in my "Notes," published in 1860, p. 25, and my 'North-Atlantic Sea-bed,' published in 1862, pp. 105 to 113. To that explanation nothing material has been since added, although both Dr. Carpenter and Dr. Thomson have most freely used the same arguments and illustrations. The proposal made in the text was to ascertain the pressure at any required depth, by an instrument I designed with this object, in order to compare the results with the theoretical estimate. The action of light had in like manner been discussed in my work (*cit. sup.*, pp. 129 to 133)—the condition of the Cave Fauna, the effect on colour, and on the organs of sight being each investigated in detail.